

MICHIGAN MOLECULAR INSTITUTE (MMI)

# Recycling Mixed Plastics

*Like turning swords into plowshares, the idea of turning waste plastics into fence posts, park benches, building blocks, and other useful, long-lasting items holds tremendous promise for the welfare of society. Wood rots, iron rusts, and stones weather, but plastic endures. You can tear, bend, or break plastic. But words like “rot” or “rust” simply do not apply — a blessing when durability is at issue; a curse when plastics are dumped into landfills.*

## COMPOSITE PERFORMANCE SCORE

(based on a four star rating)

\* \*

### Technology to Recycle Much More Waste Plastic

The U.S. economy produces about 75 million pounds of plastic products each year, and the idea of recycling them is appealing. A problem with reusing plastics, though, is that the many kinds do not mix well in recycling processes. Recycling today requires sorting of plastics, many of which still get dumped because they are not compatible with the others. This ATP project with Michigan Molecular Institute (MMI) aimed to develop a technology that would dramatically increase the proportion of plastics that can be recycled.

---

*Wood rots, iron rusts, and stones weather,  
but plastic endures.*

---

The new technology would “compatibilize,” or alter, various plastics so they mix well in recycling. They could then be formed into pellets with essentially the characteristics of virgin plastics. These pellets would be mixed into a slurry fed into a continuous flow process that puts out a mixed plastic strong enough for construction materials.

A key technical goal of the project was to develop the science and technology of polymer compatibilization, which would enable polymers in the commingled plastic-waste stream to be recycled into commercially useful products. Collaborating researchers from Eastman

Kodak, Eastman Chemical, and the University of Florida (UF) accomplished that goal by establishing the fundamentals of compatibilization of multiphase polymer blends, including new knowledge about the morphology — the shape and structure — of polymer blends. The team also prepared compatibilizers using a variety of chemical approaches and produced and tested prototype compatibilized materials. Researchers found effective methods to compatibilize commingled-plastic waste.

### New Recycled-Plastic Products

Results of the ATP project are being used by Eagle Plastics Systems of Florida to produce compatibilized plastic panels for housing parts, in collaboration with UF researchers who were involved in the ATP project.

---

*...a curse when plastics are dumped into  
landfills.*

---

Large four-inch-thick panels are fabricated by sandwiching fiberglass insulation between thin plastic sheets attached to galvanized steel studs. These wall units are then used for the construction of low cost, modular houses, many of which are used following a fire or other disaster, when temporary housing must be built quickly. The company plans to construct full-scale compatibilized plastic-panel manufacturing plants in the near future.

## PROJECT HIGHLIGHTS

### Project:

different plastics to make them chemically compatible so that the material fabricated from them has good mechanical and physical properties. This technology would greatly increase the amount of waste plastic that can be recycled.

**Duration:** 8/15/1992 - 8/14/1995

**ATP Number:** 91-01-0088

### Funding (in thousands):

ATP	\$1,642	30%
Company	<u>3,808</u>	70%
Total	\$5,450	

### Accomplishments:

MMI researchers and their collaborators established the fundamentals of polymer compatibilization, which enables polymers in a waste stream of different kinds of plastics to be recycled into commercially useful products. Indicators of this accomplishment are that MMI and its collaborators:

- published more than 10 papers on the technology in professional journals;

- made the technology available to Eagle Plastics Systems to develop and test materials for the housing construction industry; and

- made the technology available through MMI to two ongoing R&D projects in the automobile industry that focus on recycling plastics from auto parts such as dashboards, door panels and tail lights.

### Commercialization Status:

One collaborating company has begun to use the technology in the construction of low-cost modular houses. Information on the technology generated by the project is now available to the plastics and recycling industries via published technical papers, and some of it is being used in additional research projects.

### Outlook:

Commercialization is underway and is expected to increase substantially in the construction of modular housing. The technical base developed in this project is also being used in two new projects that focus on recycling plastic auto parts.

### Composite Performance Score: \* \*

### Company:

Michigan Molecular Institute (MMI)  
1910 W. St. Andrews Road  
Midland, MI 48640-2696

**Contact:** Conrad F. Balazs

**Phone:** (517) 832-3882 ext. 590

**Informal Collaborator:** University of Florida;  
Eagle Plastics Systems; Eastman Kodak Company;  
Eastman Chemical Company; Inter Recycling, Inc.

Eagle constructed an assembly plant in Kentucky and began manufacturing modular houses there in late 1996. It uses recycled plastics brought from a pilot plant to the site by railroad cars that left the state loaded with coal.

---

*Results of the ATP project are being used by Eagle Plastics Systems of Florida to produce compatibilized plastic panels for housing parts...*

---

Because of the extremely low cost of the recycled plastics, the company can manufacture its houses for about \$6 per square foot, much lower than the cost of conventional housing, which runs as high as \$50 per square foot. During its first year producing the modular houses, Eagle generated more than \$100 million in contracts.

In addition, attempts to commercialize the technology

are under way via the development of two new MMI research and development projects in the auto industry that focus on recycling plastics from auto parts such as dashboards and door panels. Both projects rely on the knowledge of polymer blend morphology discovered in the ATP project. If these projects generate applications in the auto industry, the ATP technology will be commercialized via that route, as well. knowledge of polymer blend morphology discovered in the ATP project. If these projects generate applications in the auto industry, the ATP technology will be commercialized via that route, as well.

Commercialization efforts did not proceed as quickly as anticipated when the proposal was submitted. One obstacle to the speed of commercialization was a change in ownership and direction of Waste Alternatives, one of the initial collaborators on the project and the company that was planned to play a key role in commercializing the technology.

### ATP Funding Critical for Recycling Research

Without the ATP award, MMI officials say, the project

would not have been undertaken. The funding helped MMI forge relations with research partners at the University of Florida, Eagle, Eastman Kodak, and Eastman Chemical. Research on post-consumer plastics packaging recycling, based on the ATP-funded technology and substantial funding from Eagle, is continuing at the university. In addition, researchers there have extended the ATP technology to develop new virgin plastics alloys that are expected to lead to further commercialization. A 30-acre plastics recycling industrial park is being constructed on land owned by the UF Foundation, and continuing support for research amounting to about \$100 million over the next 15 years is anticipated.

---

*One obstacle to the speed of  
commercialization was a change in  
ownership...*

---

In addition, the use of knowledge developed by the ATP project may have advanced the two succeeding studies at MMI for recycled plastics parts in the auto industry by as much as two years. The scientific information generated by the ATP project has also been made generally available, via published technical papers, to the plastics and recycling industries.